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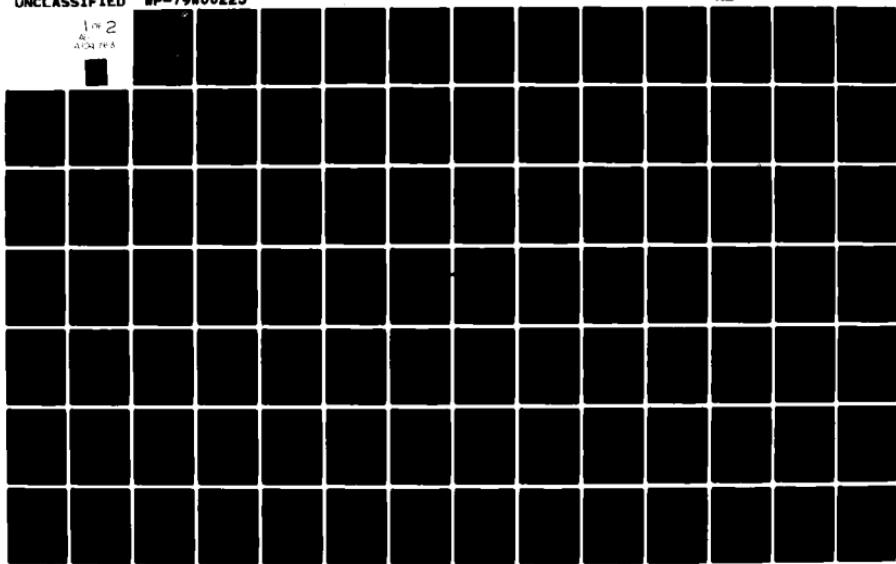
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EVALUATION OF SHORT-TERM BIOASSAYS TO PREDICT FUNCTIONAL IMPAIRMENT

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DEVELOPMENT OF HEPATIC BIOASSAYS IN LABORATORY ANIMALS

DIRECTORY OF INSTITUTIONS/INDIVIDUALS Final Report

Purna Greenaway, Jim Konz, Richard Thomas

October 1980

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US Army Medical Research and Development Command
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The MITRE Corporation
1820 Dolley Madison Boulevard
McLean, Virginia 22102

Contracting Officer's Technical Representative: Mary C. Henry, Ph.D.
US Army Medical Bioengineering Research and Development Laboratory
Fort Detrick, Maryland 21701



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measurements performed, test systems employed, compounds tested, requirements for anesthesia, and the terminal nature of the test.

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EXECUTIVE SUMMARY

The MITRE Corporation, Metrek Division is currently assisting the United States Army Medical Bioengineering Research and Development Laboratory (USAMBRDL) in the development of a hierarchical short-term testing scheme to screen substances for functional or morphological impairment in animal test systems. Effects in four organ systems--pulmonary, hepatic, renal, and cardiovascular--are being considered.

As part of this effort, Metrek has been asked to prepare directories of organizations and individuals presently involved in the development and/or utilization of tests applicable to toxicity screening. This directory serves as a companion document to the report entitled Evaluation of Short-Term Bioassays to Predict Functional Impairment: Selected Short-Term Hepatic Toxicity Tests, which presents information on the available tests for the hepatic system and recommends those tests that are suitable for use in a screening program. Test procedures for determining toxic effects on the liver are discussed in the report in sections on morphology, function, and biochemistry. Criteria for evaluating the procedures are given, and a three-tiered testing system is recommended for a chemical hepatotoxicity screening program.

Entries in each directory for several organizations currently involved in the organ bioassay use or development include at least one contact individual's name, which appears under the organization

name and address at the top of the page. These are the people who, during the process of directory compilation, described either their activities or the activities of their group regarding organ toxicity testing, and thereby provided the information presented in the entry. The information provided includes the specific tests and observations performed; the test systems utilized (e.g., experimental animals or tissues in vitro); the substances administered or conditions established to elicit toxic response (e.g., stress); the use of anesthesia, and the terminal nature of the tests conducted.

In order to facilitate use and the processes of amending and adding to the directory, it has been arranged in alphabetical order by organization. In order to further simplify use of the directory, three indexes have been prepared and are included as appendices. The first, Appendix A, is an alphabetical index of tests performed by each organization engaged in developing, performing or refining the tests noted. Appendix B is an alphabetic index of species utilized and all the organizations employing each test system. These are further divided by tests performed. In this way it is possible to ascertain which organizations perform particular bioassays in a specific test system. Appendix C is an alphabetical index of the individuals mentioned in the directory, and the organization with which they were affiliated when contacted.

The objective of this directory is to provide a readily usable guide to that segment of the scientific community currently active

in organ system toxicity testing in animals. Because research associate and graduate student positions are often temporary in nature, a deliberate attempt was made to exclude these individuals from the directory. Their efforts, however, are likely to be represented by activities associated with their organization, as in most cases these individuals are conducting research under the auspices of someone more senior and more permanently allied with the organization, who was included in the directory. In addition, there are individuals who were active in toxicity testing at one time but are no longer; these have also been omitted from the directory. The efforts of many of those who are not currently active, but were involved over a period of many years and distinguished themselves in the field, are reflected in the report, Selected Short-Term Hepatic Toxicity Tests.

Some of the entries in this directory may be less detailed than others, and less specific in the detail that is presented. In addition, the information presented for an organization may not be reflective of all the ongoing efforts at that organization. This is due largely to the reluctance of some individuals contacted to communicate the information and, in small part, to an inability to contact a few individuals at the time this directory was being compiled. The information in the directory was selected to provide an immediate indication of the practices of each organization concerning some issues of importance when designing a screening program. Much of this information is discussed in greater detail in the report Selected Short-Term Hepatic Toxicity Tests.

FOREWORD

This Directory was compiled by MITRE staff by means of a survey of the recent literature, and by discussions with leaders in the field and other personal contacts. We are grateful to all those who responded so patiently to our questions regarding their activities. All of the "contact persons" were given an opportunity to review the information relating to their organization. We recognize there may be inadvertent omissions for which we offer our sincere apologies.

Citations of organizations and trade names in this report do not constitute an official Department of the Army endorsement or approval of the products or services of these organizations.

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DIRECTORY OF ORGANIZATIONS
CURRENTLY INVOLVED IN UTILIZATION
OR DEVELOPMENT OF HEPATIC TESTS IN ANIMALS

ORGANIZATION:

ABBOTT LABORATORIES
ABBOTT PARK, NORTH
CHICAGO, ILLINOIS 60064

J. W. KESTERSON (312)937-5763 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY
ELECTRON MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION
BILIRUBIN

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
CARBOHYDRATE METABOLISM
LIPID METABOLISM
PROTEIN METABOLISM
VITAMIN METABOLISM
LEVELS OF SERUM METALS AND ELECTROLYTES

TEST SYSTEMS UTILIZED:

RATS, DOGS, MONKEYS, MICE

COMPOUNDS TESTED:

ETHICAL PHARMACEUTICALS, PESTICIDES, INDUSTRIAL
CHEMICALS, HOSPITAL PRODUCTS, DEVICES, PLASTICS

ORGANIZATION:

ALBERT EINSTEIN COLLEGE OF MEDICINE
1300 MORRIS PARK AVENUE
LIVER RESEARCH CENTER
BRONX, NEW YORK 10461

R. CHOWDHURY (202)430-2379 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY
ELECTRON MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION
BILIRUBIN
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
LIPID METABOLISM
PROTEIN METABOLISM
XENOBIOTIC METABOLISM
LEVELS OF SERUM METALS
AND ELECTROLYTES

IN VITRO TECHNIQUES ISOLATED PERFUSED LIVER
HEPATOCYTES
HEPATOMA CELLS
MEMBRANE INTEGRITY

TEST SYSTEMS UTILIZED:

RATS, RABBITS, MICE, GOATS, SHEEP, FISH

COMPOUNDS TESTED:

BILIRUBIN, DRUGS, POISONS (CARCINOGENS)
VIRUSES, PROTEINS

REMARKS:

W. LEVINE, I. ARIAS AND J. SWANEY ARE ALSO INVOLVED IN
HEPATOTOXICITY TESTING.

ORGANIZATION:

AMERICAN HEALTH FOUNDATION
VALHALLA, NEW YORK 10595

D. HOFFMAN (914) 592-2600 (CONTACT)

TESTS PERFORMED:

STUDIES ARE GEARED TOWARD HEPATOCARCINOGENS AND MUTAGENS
(i.e., TUMORIGENIC ACTIVITY AND DNA REPAIR)

TEST SYSTEMS UTILIZED:

MICE, RATS, RABBITS

COMPOUNDS TESTED:

ACETYLAMINE, BENZOPYRENE

REMARKS:

G. WILLIAMS IS ALSO INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

BAYLOR COLLEGE OF MEDICINE
1200 MOURSUND
HOUSTON, TEXAS 77030

H. HUGHES (713)790-4721 (CONTACT)

TESTS PERFORMED:

BIOCHEMICAL TESTS: LIPID METABOLISM
XENOBIOTIC METABOLISM

TEST SYSTEMS UTILIZED:

MICE, RATS

COMPOUNDS TESTED:

KNOWN HEPATOTOXINS

REMARKS:

J. MITCHELL, G. COCHRAN, C. SMITH, AND B. LAUTERBURG ARE ALSO INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

BIO-DYNAMICS
EAST MILLSTONE, NEW JERSEY 08873

T. RUSSELL (201)873-2550 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: LIGHT MICROSCOPY
ELECTRON MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION (BSP, ICG)
BILIRUBIN (SERUM AND URINE LEVELS)
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS (COMPREHENSIVE)
CARBOHYDRATE METABOLISM (GLUCOSE LEVELS)
LIPID METABOLISM (CHOLESTEROL LEVELS)
PROTEIN METABOLISM (SERUM LEVELS,
ELECTROPHORESIS)
LEVELS OF SERUM METALS AND ELECTROLYTES
VITAMIN METABOLISM
DETOXIFICATION OR SYNTHESIS OF
ESSENTIAL BODY CONSTITUENTS

TEST SYSTEMS UTILIZED:

DOGS, GUINEA PIGS, HAMSTERS, MICE, MONKEYS, RABBITS, RATS

COMPOUND TESTED:

PHARMACEUTICALS, INDUSTRIAL CHEMICALS, PESTICIDES,
FOOD ADDITIVES

REMARKS:

W. RINEHART, G. HOGAN, J. OGRODNICK AND A. KNESEVITCH ARE
ALSO INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

CHEMICAL INDUSTRY INSTITUTE OF TOXICOLOGY
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709

E. BERMUDEZ (919) 541-2070 (CONTACT)

TESTS PERFORMED:

DNA REPAIR IN PRIMARY RAT HEPATOCYTES

DNA DAMAGE AS MEASURED BY ALKALINE ELUTION

CHINESE HAMSTER OVARY/HYPOXANTHINE-GUANINE PHOSPHORIBOSYL
TRANSFERASE MUTATIONAL ASSAY

TEST SYSTEMS UTILIZED:

RATS (IN VIVO AND IN VITRO PREPARATIONS)

COMPOUNDS TESTED:

POLYCYCLIC HYDROCARBONS
NITROSOAMINES
MYCOTOXINS
AZO DYES
AROMATIC NITRO COMPOUNDS
AROMATIC AMINES

REMARKS:

BASIC RESEARCH IS IN DNA DAMAGE AND REPAIR INDUCED BY CHEMICALS.

B. BUTTERWORTH IS ALSO INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

CHEMICAL INDUSTRY INSTITUTE OF TOXICOLOGY
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709

J. BOND (919)541-2070 x 250 (CONTACT)

TESTS PERFORMED:

NOT INVOLVED WITH SCREENING TESTS: WORK IS IN BASIC RESEARCH

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

KNOWN CARCINOGENS (e.g., DINITROTOLUENE)

REMARKS:

BASIC RESEARCH IS IN MECHANISM OF HEPATOCYTE METABOLISM AND
ISOLATED PERFUSED LIVER.

ORGANIZATION:

CHEMICAL INDUSTRY INSTITUTE OF TOXICOLOGY
P.O. BOX 12137
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27709

E. GRALLA (919)541-2070 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY
ELECTRON MICROSCOPY

FUNCTIONAL TESTS: BILIRUBIN

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
CARBOHYDRATE METABOLISM
LIPID METABOLISM
PROTEIN METABOLISM
LEVELS OF SERUM METALS
AND ELECTROLYTES

IN VITRO TECHNIQUES: HEPATOCYTES

TEST SYSTEMS UTILIZED:

RATS, MICE

COMPOUNDS TESTED:

40 PRIORITY CHEMICALS

REMARKS:

J. POPP AND J. GIBSON ARE ALSO INVOLVED IN HEPATOTOXICITY
TESTING.

ORGANIZATION:

DOW CHEMICAL USA
MIDLAND, MICHIGAN 48640

P. GEHRING (517) 636-1089 (CONTACT)

TESTS PERFORMED:

HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION (BROMSUL PHALEIN, BSP)
BILIRUBIN (BILIARY TRANSPORT MAXIMUM)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS (LACTIC ACID DE-
HYDROGENASE, LDH AND OTHERS)
PROTEIN METABOLISM (TURNOVER OF
 C_{14} -LABELLED COMPOUNDS)
NITROGEN METABOLISM (UREAGENESIS)
LIPID METABOLISM (PHOSPHOLIPID
LABELS)
XENOBIOTIC METABOLISM

IN VITRO TECHNIQUES: CULTURED HEPATOCYTES

TEST SYSTEMS UTILIZED:

RATS, MICE, DOGS, MONKEYS

COMPOUNDS TESTED:

PESTICIDES, SOLVENTS, MONOMERS, ETC.

REMARKS:

ALSO INVOLVED IN DNA REPAIR AND TURNOVER WITH IN VITRO
HEPATOCYTES.

B.A. SCHWETZ AND R.J. KOCIBA ARE ALSO INVOLVED IN HEPATOTOXICITY
TESTING.

ORGANIZATION:

DUKE MEDICAL CENTER
DEPARTMENT OF PATHOLOGY
DURHAM, NORTH CAROLINA 27710

G. MICHALOPOULOS (919) 684-2779 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: PHASE-CONTRAST MICROSCOPY

BIOCHEMICAL TESTS: XENOBIOTIC METABOLISM IN THE CYTOCHROME P450 SYSTEM

IN VITRO TECHNIQUES: DNA REPAIR IN RAT HEPATOCYTES AND HUMAN FIBROBLASTS

TEST SYSTEMS UTILIZED:

HUMAN FIBROBLASTS AND RAT HEPATOCYTES

COMPOUNDS TESTED:

BENZO(A)PYRENE, AAF (ACETYLAMINOFLUORENE) AFLATOXINS
DIETHYLNITROSAMINE

ORGANIZATION:

EXXON CORPORATION
RESEARCH AND ENVIRONMENTAL HEALTH DIVISION
EAST MILLSTONE, NEW JERSEY 08873

R. STAAB (201)873-6050 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION

FUNCTIONAL TESTS: DYE EXCRETION (BSP)
BILIRUBIN (SERUM LEVELS)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
CARBOHYDRATE METABOLISM
(GLUCOSE LEVELS)
LIPID METABOLISM (CHOLESTEROL LEVELS)
PROTEIN METABOLISM (SERUM AND URINE
PROTEIN LEVELS)
DETOXIFICATION (DEVELOPMENTAL STAGE)
PRODUCT SYNTHESIS

TEST SYSTEMS UTILIZED:

DOGS, MICE, RABBITS, RATS

COMPOUNDS TESTED:

HYDROCARBONS, PETROCHEMICALS, SOLVENTS, AND PETROLEUM
ADDITIVES

REMARKS:

SCREENING PROGRAM IS NOT LIMITED TO THE HEPATIC SYSTEM.

R. SCALA, S. LEWIS, AND G.F. EGAN ARE ALSO INVOLVED IN
HEPATOTOXICITY TESTING.

ORGANIZATION:

FOOD AND DRUG RESEARCH LABORATORIES
EAST ORANGE
NEW JERSEY 07078

H. FEINMAN (201)677-9500 (CONTACT)

TESTS PERFORMED:

FUNCTIONAL TESTS: DYE EXCRETION TEST (BSP)
BILIRUBIN (SERUM BILIRUBIN AND
UROBILINOGEN LEVELS)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS (COMPREHENSIVE)
CARBOHYDRATE METABOLISM (COMPREHENSIVE)
LIPID METABOLISM (COMPREHENSIVE)
PROTEIN METABOLISM (COMPREHENSIVE)
(PROTEIN EFFICIENCY RATIO FOR FOODS AND
ADDITIVES)
LEVELS OF SERUM METALS AND ELECTROLYTES
(COMPREHENSIVE)
VITAMIN METABOLISM
DETOXIFICATION
PRODUCT SYNTHESIS (ANTIDOTAL STUDIES)

TEST SYSTEMS UTILIZED:

CATS, DOGS, GUINEA PIGS, HAMSTERS, HUMANS, MICE, MONKEYS,
PIGS, RATS

COMPOUNDS TESTED:

A WIDE VARIETY OF COMPOUNDS HAVE BEEN TESTED.

REMARKS:

R. PARENT, P. BECCI, AND G. COX ARE ALSO INVOLVED IN
HEPATOTOXICITY TESTING.

ORGANIZATION:

FOOD RESEARCH INSTITUTE
UNIVERSITY OF WISCONSIN, MADISON
1925 WILLOW DRIVE
MADISON, WISCONSIN 53706

M. PARIZA (608)263-6955 (CONTACT)
263-7777

TESTS PERFORMED:

MORPHOLOGICAL AND
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

FUNCTIONAL TESTS: MEMBRANE INTEGRITY

BIOCHEMICAL TESTS: XENOBIOTIC METABOLISM
DRUG METABOLISM

IN VITRO TECHNIQUES: HEPATOCYTES
HEPATOMA CELLS

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

AFLATOXIN B₁, AMINOFLUORENE, CLOSTRIDIUM PERFRINGENS ENTEROTOXIN

REMARKS:

EMPHASIS IS ON MUTAGENESIS

ORGANIZATION:

G.D. SEARLE AND COMPANY
BOX 5110
CHICAGO, ILLINOIS 60680

D. DODD (312)982-7000 x4981 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS:	GROSS OBSERVATION LIGHT MICROSCOPY ELECTRON MICROSCOPY
FUNCTIONAL TESTS:	DYE EXCRETION BILIRUBIN
BIOCHEMICAL TESTS:	SERUM ENZYME LEVELS CARBOHYDRATE METABOLISM LIPID METABOLISM PROTEIN METABOLISM XENOBIOTIC METABOLISM LEVELS OF SERUM METALS AND ELECTROLYTES DETOXIFICATION PRODUCT SYNTHESIS

TESTS SYSTEMS UTILIZED:

DOGS, RATS, MONKEYS, MICE

COMPOUNDS TESTED:

PHARMACEUTICALS

REMARKS:

V. JASTY AND F. KOTSONIS ARE ALSO INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

GEORGE WASHINGTON UNIVERSITY HOSPITAL
DEPARTMENT OF GASTROENTEROLOGY
WASHINGTON, D.C. 20037

H. ZIMMERMAN (202) 676-4418 (CONTACT)

TESTS PERFORMED:

FUNCTIONAL TESTS: DYE EXCRETION

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
XENOBIOTIC METABOLISM

IN VITRO TECHNIQUES: PERFUSED LIVER
HEPATOCYTE SUSPENSION

TEST SYSTEMS UTILIZED:

PERFUSED RAT LIVER AND HEPATOCYTE CULTURE.

COMPOUNDS TESTED:

CARBON TETRACHLORIDE, ENDOTOXINS, DRUGS

ORGANIZATION:

HAZLETON LABORATORIES
VIENNA, VIRGINIA 22180

M. STEINBERG (703)893-5400 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: ELECTRON MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION (BSP)
BILIRUBIN (INDIRECT AND DIRECT)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS (STANDARD)
CARBOHYDRATE METABOLISM (GLUCOSE LEVEL)
PROTEIN METABOLISM (URIC ACIDS, BUN,
SERUM ELECTROPHORESIS AND CREATINE LEVELS)
LIPID METABOLISM (CHOLESTEROL AND FREE
FATTY ACID LEVELS)
DETOXIFICATION
PRODUCT SYNTHESIS

TEST SYSTEMS UTILIZED:

GUINEA PIGS, MICE, MONKEYS, RABBITS, RATS, AND DOGS

COMPOUNDS TESTED:

AGRICULTURAL CHEMICALS (e.g., PESTICIDES), DRUGS, GENERAL
CHEMICALS, COSMETICS, DYES, MILITARY CHEMICALS, ETC.

ORGANIZATION:

HOFFMAN LaROCHE INCORPORATED
NUTLEY, NEW JERSEY 07110

E. FITZER (201)235-3028 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION (BSP)
BILIRUBIN (SERUM LEVEL)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
CARBOHYDRATE METABOLISM (SERUM GLUCOSE)
LIPID METABOLISM (CHOLESTEROL AND
TRIGLYCERIDE)
PROTEIN METABOLISM (SERUM PROTEIN
LEVELS)
NITROGEN METABOLISM (UREAGENESIS)
VITAMIN METABOLISM
LEVELS OF SERUM ELECTROLYTES AND METALS

TEST SYSTEMS UTILIZED:

DOGS, GUINEA PIGS, MICE, MONKEYS, RABBITS, RATS

COMPOUNDS TESTED:

A WIDE VARIETY OF INDUSTRIAL CHEMICALS AND DRUGS HAVE BEEN
TESTED.

REMARKS:

A. CONNEY AND S. KAPLAN ARE ALSO INVOLVED IN HEPATOTOXICITY
TESTING.

ORGANIZATION:

INTERNATIONAL RESEARCH AND DEVELOPMENT CORPORATION
MATTAWAN, MICHIGAN 40971

E. GOLDENTHAL (616)668-3336 (CONTACT)

TESTS PERFORMED:

HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

FUNCTIONAL TESTS: BILIRUBIN (SERUM BILIRUBIN LEVEL)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS (COMPREHENSIVE)
CARBOHYDRATE METABOLISM (COMPREHENSIVE)
LIPID METABOLISM (COMPREHENSIVE)
PROTEIN METABOLISM (COMPREHENSIVE)
LEVELS OF SERUM METALS AND ELECTROLYTES (COMPREHENSIVE)
VITAMIN METABOLISM
DETOXIFICATION
PRODUCT SYNTHESIS (HIPPURIC ACID EXCRETION, PLASMA LEVELS OF COAGULATION FACTORS)

TEST SYSTEMS UTILIZED:

CHICKENS, DOGS, GUINEA PIGS, HAMSTERS, MICE, MONKEYS,
PIGS, RATS, AND RABBITS

COMPOUNDS TESTED:

A WIDE VARIETY OF COMPOUNDS HAVE BEEN TESTED.

ORGANIZATION:

LITTON BIONETICS INCORPORATED
KENSINGTON, MARYLAND 20795

R. WEIR, OR H. GISS (301)881-5600 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION (BSP)
BILIRUBIN (URINARY AND BLOOD LEVELS)

BIOCHEMICAL TESTS: SERUM ENZYMES (COMPREHENSIVE)
CARBOHYDRATE METABOLISM (GLUCOSE LEVELS)
LIPID METABOLISM (CHOLESTEROL)
PROTEIN METABOLISM (SERUM LEVELS)
XENOBIOTIC METABOLISM
LEVELS OF SERUM ELECTROLYTES AND METALS

TEST SYSTEMS UTILIZED:

DOGS, MICE, MONKEYS, RATS

COMPOUNDS TESTED:

SOLVENTS	INDUSTRIAL CHEMICALS
PESTICIDES	PETROCHEMICALS
DRUGS	FOOD COLORS

REMARKS:

F. MECKLER AND C. JOHNSON ARE ALSO INVOLVED IN
HEPATOTOXICITY TESTING.

ORGANIZATION:

3M-RIKER LABORATORIES
3M CENTER
ST. PAUL, MINNESOTA 55144

M. CASE (612) 733-5180 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

FUNCTIONAL TESTS: BILIRUBIN (SERUM LEVEL)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
PROTEIN METABOLISM (BUN MEASUREMENT AND
SERUM PROTEIN LEVELS)
CARBOHYDRATE METABOLISM (BLOOD GLUCOSE
LEVEL)
LIPID METABOLISM (CHOLESTEROL LEVEL)
SERUM ELECTROLYTES (Na^+ , K^+ , Cl^-)

TEST SYSTEMS UTILIZED:

DOGS, RATS

COMPOUNDS TESTED:

PHARMACEUTICALS
AGRO-CHEMICALS (e.g., HERBICIDES)
INDUSTRIAL COMPOUNDS - INFORMATION IS PROPRIETARY.

REMARKS:

R. NELSON, E. LAMPRECHT AND R. STEFFEN ARE ALSO INVOLVED IN
HEPATOTOXICITY TESTING.

ORGANIZATION

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
50 AMES STREET
CAMBRIDGE, MASSACHUSETTS 02139

P. NEWBERNE (617)253-6243 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY
HISTOCHEMISTRY

FUNCTIONAL TESTS: BILIRUBIN
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: TISSUE ENZYME LEVELS
LIPID METABOLISM
PROTEIN METABOLISM
DRUG METABOLISM
LEVELS OF SERUM METALS AND
ELECTROLYTES
LEVELS OF TISSUE (LIVER) METALS
VITAMIN ASSAYS
DETOXIFICATION

TEST SYSTEMS UTILIZED:

RATS, MICE, HAMSTERS, GUINEA PIGS, RABBITS, DOGS, MONKEYS

COMPOUNDS TESTED:

DRUGS, PURE CHEMICALS (PESTICIDES), NATURAL PRODUCTS (ALKALOIDS)

ORGANIZATION:

MEDICAL COLLEGE OF VIRGINIA
DEPARTMENT OF PATHOLOGY
RICHMOND, VIRGINIA 23298

P. GUZELIAN (904)786-9693 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
CARBOHYDRATE METABOLISM (SUGAR
METABOLISM
LIPID METABOLISM (PHOSPHOLIPID
SYNTHESIS
PROTEIN METABOLISM (FIBRINOGEN
AND ALBUMIN SYNTHESIS)
XENOBIOTIC METABOLISM IN THE CYTOCHROME
P450 SYSTEM

IN VITRO TECHNIQUES: CULTURED HEPATOCYTES

TEST SYSTEMS UTILIZED:

HEPATOCYTE-CULTURE MEDIUM: RATS

COMPOUNDS TESTED:

CARCINOGENS, STEROIDS, MYCOTOXINS, METALS

REMARKS:

F. FALLON AND D. GOLDMAN ARE ALSO INVOLVED IN HEPATOTOXICITY
TESTING.

ORGANIZATION:

MIDWEST RESEARCH INSTITUTE
425 VOLKER BLVD.
KANSAS CITY, MISSOURI 64110

T. SHELLENBERGER (816) 753-7600 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION
BILIRUBIN
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
CARBOHYDRATE METABOLISM
LIPID METABOLISM
PROTEIN METABOLISM
XENOBIOTIC METABOLISM
VITAMIN METABOLISM
DRUG METABOLISM
LEVELS OF SERUM METALS AND ELECTRO-
LYTES
DETOXIFICATION
PRODUCT SYNTHESIS

IN VITRO TECHNIQUES: HEPATOCYTES
HEPATOMA CELLS

TEST SYSTEMS UTILIZED:

RATS, MICE, RABBITS, DOGS, MONKEYS, HAMSTERS, GUINEA PIGS

COMPOUNDS TESTED:

ANTI-CANCER DRUGS, NITROSAMINES, PESTICIDES, RDX, VINYL
TOLUENE, VINYLIDENE CHLORIDE, DEVELOPMENTAL COMPOUNDS

REMARKS:

B. BARNHART, H. ELLIS, M. EL-HAWARI AND J. CHOLAKIS ARE
ALSO INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

MONSANTO COMPANY
ST. LOUIS, MISSOURI 63166

F. JOHANSEN (314)694-2183 (CONTACT)

TEST PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY
ELECTRON MICROSCOPY
MORPHOMETRIC ANALYSIS

FUNCTIONAL TESTS: DYE EXCRETION
BILIRUBIN
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
CARBOHYDRATE METABOLISM (GLUCOSE, LACTASE,
RIBOSE LEVELS)
LIPID METABOLISM (CHOLESTEROL, PHOSPHO-
LIPID, FREE FATTY (ACIDS))
PROTEIN METABOLISM (SERUM AND URINE
LEVELS, URINARY CREATININE, BUN)
LEVELS OF SERUM METALS AND ELECTROLYTES
(Na⁺, Cl⁻, HEAVY METALS)
DETOXIFICATION
PRODUCT SYNTHESIS

TEST SYSTEMS UTILIZED:

DOGS, HAMSTERS, RABBITS, RATS

COMPOUNDS TESTED:

A WIDE VARIETY OF INDUSTRIAL COMPOUNDS HAVE BEEN TESTED.

REMARKS:

G. LEVINSKAS, P. WRIGHT AND R. FOLK ARE ALSO INVOLVED IN
HEPATOTOXICITY TESTING.

ORGANIZATION:

NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES
NATIONAL TOXICOLOGY PROGRAM
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709

J. HUFF (919)541-3267 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: HISTOLOGY

FUNCTIONAL TESTS: BILIRUBIN (SERUM LEVELS)
RADIOISOTOPIC TECHNIQUES (OCCASIONALLY)

BIOCHEMICAL TESTS: PROTEIN METABOLISM (LIPOPROTEINS,
ELECTROPHORESIS)
LIPID METABOLISM (CHOLESTEROL AND
TRIGLYCERIDES)
XENOBIOTIC METABOLISM
DETOXIFICATION
PRODUCT SYNTHESIS

TEST SYSTEMS UTILIZED:

DOGS, MICE, RATS

COMPOUNDS TESTED:

A WIDE VARIETY OF COMPOUNDS HAVE BEEN TESTED

REMARK:

H. MATTHEWS, J. GOLDSTEIN, W. KLUEWE AND R. CHABRA ARE ALSO
INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

NAYLOR DANA INSTITUTE
1 DANA ROAD
VALHALLA, NEW YORK 10595

G. WILLIAMS (914)592-2600 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

BIOCHEMICAL TESTS: XENOBIOTIC METABOLISM
DETOXIFICATION
PRODUCT SYNTHESIS

IN VITRO TECHNIQUES: CELL NECROSIS
DNA DAMAGE
MUTAGENESIS

TESTS SYSTEMS UTILIZED:

RATS, MICE, HAMSTERS, RABBITS

COMPOUNDS TESTED:

A WIDE VARIETY OF COMPOUNDS HAVE BEEN TESTED, INCLUDING 20
STRUCTURAL CLASSES OF AGENTS WHICH ARE ACTIVATED BY THE LIVER.

ORGANIZATION:

NEW YORK UNIVERSITY MEDICAL CENTER
NEW YORK, NEW YORK 10016

B. VAN DUUREN (212)340-5629 (CONTACT)

TESTS PERFORMED:

THE METABOLISM OF POTENTIAL CARCINOGENS IS THE PRINCIPAL FOCUS.

TEST SYSTEMS UTILIZED:

MICE, RATS

COMPOUNDS TESTED:

EPOXIDES, HALO-ETHERS, HALOGENATED HYDROCARBONS, LACTONES,
ACYLATING AGENTS.

ORGANIZATION:

RUTGERS MEDICAL SCHOOL (CMDNJ)
VIVARIUM
P.O. BOX 101
PISCATAWAY, NEW JERSEY 08854

J.R. McCOY (201)463-4570 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION
BILIRUBIN
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
CARBOHYDRATE METABOLISM
LIPID METABOLISM
PROTEIN METABOLISM
XENOBIOTIC METABOLISM
VITAMIN METABOLISM

IN VITRO TECHNIQUES: HEPATOMA CELLS

TEST SYSTEMS UTILIZED:

RATS, DOGS, MICE, RABBITS, MONKEYS

COMPOUNDS TESTED:

PESTICIDES, ORAL CONTRACEPTIVES, STEROIDS, ENDOCRINE SUBSTANCES,
OCCUPATIONAL CHEMICALS (e.g., HEAVY METALS), WRAPPING PLASTICS

ORGANIZATION:

STERLING WINTHROP RESEARCH INSTITUTE
DEPARTMENT OF TOXICOLOGY
RENSSELAER, NEW YORK 12144

H.P. DROBECK (518)445-8316 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY
ELECTRON MICROSCOPY

FUNCTIONAL TESTS: BILIRUBIN

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
LEVELS OF SERUM METALS AND
ELECTROLYTES

TEST SYSTEMS UTILIZED:

MICE, RATS, HAMSTERS, RABBITS, GUINEA PIGS, DOGS, MONKEYS

COMPOUNDS TESTED:

PHARMACEUTICALS, MEDICINALS

ORGANIZATION:

STERLING WINTHROP RESEARCH INSTITUTE
DEPARTMENT OF DRUG METABOLISM AND DISPOSITION
RENSSELAER, NEW YORK 12144

J. EDELSON (518)445-8241 (CONTACT)

TESTS PERFORMED:

FUNCTIONAL TESTS: RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: XENOBIOTIC METABOLISM (MICROSOMAL
PREPARATIONS)
DETOXIFICATION
BIOSYNTHESIS

TEST SYSTEMS UTILIZED:

RATS, DOGS, MONKEYS, HUMANS

COMPOUNDS TESTED:

PHARMACEUTICALS, NATURALLY OCCURRING ENZYMES

ORGANIZATION:

TEMPLE UNIVERSITY
DEPARTMENT OF PATHOLOGY
PHILADELPHIA, PENNSYLVANIA 19140

J.L. FARBER (215)221-4155 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: LIGHT MICROSCOPY

BIOCHEMICAL TESTS: LIPID METABOLISM (PHOSPHOLIPIDS)
XENOBIOTIC METABOLISM IN THE CYTOCHROME
P450 SYSTEM

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

HALOGENATED HYDROCARBONS

REMARKS:

PRINCIPAL RESEARCH INTERESTS ARE THE MECHANISMS OF HEPATOTOXI-
CITY.

ORGANIZATION:

TEMPLE UNIVERSITY SCHOOL OF MEDICINE
SECTION OF CLINICAL PHARMACOLOGY
3420 N. BROAD STREET
PHILADELPHIA, PENNSYLVANIA 19140

M. BLACK (214)221-3434 (CONTACT)
221-3260

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION
BILIRUBIN
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
XENOBIOTIC METABOLISM
LEVELS OF SERUM METALS AND ELECTROLYTES
DRUG METABOLISM
DETOXIFICATION
PRODUCT SYNTHESIS

TEST SYSTEMS UTILIZED:

RATS, MICE

COMPOUNDS TESTED:

THERAPEUTIC AGENTS

REMARKS:

J. O'NEIL IS ALSO INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

THE UPJOHN COMPANY
301 HENRIETTA STREET
KALAMAZOO, MICHIGAN 49001

H. WEBSTER (616) 385-7439 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND
HISTOPATHOLOGICAL TESTS: LIGHT MICROSCOPY

FUNCTIONAL TESTS: BILIRUBIN

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
CARBOHYDRATE METABOLISM
DRUG METABOLISM
LIPID METABOLISM
PROTEIN METABOLISM
VITAMIN METABOLISM
LEVELS OF SERUM METALS AND ELECTRO-
LYTES

TEST SYSTEMS UTILIZED:

RATS, DOGS, MICE, MONKEYS

COMPOUNDS TESTED:

PHARMACEUTICALS

REMARKS:

J. GRAY, R. PIPER, G. ELLIOTT, Y. YUAN, G. KOLAJA, AND
D. STEVENS ARE ALSO INVOLVED IN HEPATOTOXICITY TESTING.

D. SWENSEN (385-7352) IS INVOLVED WITH IN VITRO TECHNIQUES
AT THIS ORGANIZATION BUT COULD NOT BE REACHED.

ORGANIZATION:

THOMAS JEFFERSON UNIVERSITY
DEPARTMENT OF PHARMACOLOGY
1020 LOCUST STREET
PHILADELPHIA, PENNSYLVANIA 19107

C. WITMER (215)928-8963 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY
ELECTRON MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION
RADIOISOTOPIC TECHNIQUES
MEMBRANE INTEGRITY

BIOCHEMICAL TESTS: TISSUE ENZYME LEVELS
PROTEIN METABOLISM
XENOBIOTIC METABOLISM
DETOXIFICATION
PRODUCT SYNTHESIS

IN VITRO TECHNIQUES: HEPATOCYTES

TEST SYSTEMS UTILIZED:

RATS, RABBITS, MICE, HAMSTERS

COMPOUNDS TESTED:

BENZENE, CCl_4 , METALS, 4-NITROQUINOLINE OXIDE

REMARKS:

MUTAGENICITY TESTING IS A LARGE PART OF THE WORK DONE BY
THIS GROUP.

R. SNYDER AND J. KOCSIS ARE ALSO INVOLVED IN HEPATOTOXICITY
TESTING.

ORGANIZATION:

UNION CARBIDE CORPORATION
BUSHY RUN RESEARCH CENTER
RD 4 MELLON ROAD
EXPORT, PENNSYLVANIA 15632

E. FOWLER (412)327-1020 (CONTACT)

TESTS PERFORMED:

HISTOPATHOLOGICAL TESTS: LIGHT MICROSCOPY
MORPHOMETRIC ANALYSIS

FUNCTIONAL TESTS: DYE EXCRETION (ICG AND BSP)

BIOCHEMICAL TESTS: XENOBIOTIC METABOLISM
(RADIO-LABELED METABOLITE
CLEARANCE)
LEVELS OF SERUM METALS
AND ELECTROLYTES (Na^+ , Cl^- , K^+)

TEST SYSTEMS UTILIZED:

RATS, MICE, DOGS

COMPOUNDS TESTED:

EXPERIMENTAL PESTICIDES, INDUSTRIAL INTERMEDIATES AND
PRODUCTS (INFORMATION IS PROPRIETARY)

REMARKS:

E. HOMAN, R. YANG AND L. DEPASS ARE ALSO INVOLVED IN
HEPATOTOXICITY TESTING.

ORGANIZATION:

UNIVERSITY OF ARIZONA
ARIZONA HEALTH SCIENCE CENTER
1501 N. CAMPBELL AVENUE
TUSCON, ARIZONA 85724

G. SIPES (602)626-7123 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND
HISTOPATHOLOGICAL TESTS: LIGHT MICROSCOPY

FUNCTIONAL TESTS: MEMBRANE INTEGRITY

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
PROTEIN METABOLISM
XENOBIOTIC METABOLISM
DETOXIFICATION
PRODUCT SYNTHESIS

IN VITRO TECHNIQUES: HEPATOCYTES
HEPATOMA CELLS

TEST SYSTEMS UTILIZED:

RATS, MICE

COMPOUNDS TESTED:

ANESTHETICS, ALIPHATIC HALOGENATED HYDROCARBONS, NITROSAMINES,
ETHIONINE

ORGANIZATION:

UNIVERSITY OF CALIFORNIA, IRVINE
DEPARTMENT OF COMMUNITY AND ENVIRONMENTAL MEDICINE
COLLEGE OF MEDICINE
IRVINE, CALIFORNIA 92717

R. SHANK (714)833-5186 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

FUNCTIONAL TESTS: RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: XENOBIOTIC METABOLISM
DETOXIFICATION
PRODUCT SYNTHESIS

TEST SYSTEMS UTILIZED:

RATS, MICE, HAMSTERS

COMPOUNDS TESTED:

HYDRAZINE COMPOUNDS, N-NITROSAMINES

REMARKS:

ALSO CONCERNED WITH DEVELOPMENTAL TESTS INVOLVING ABERRANT
METHYLATION OF DNA AS RESULT OF CHEMICAL INSULT TO LIVER.

ORGANIZATION:

UNIVERSITY OF CALIFORNIA, SAN FRANCISCO
DEPARTMENT OF PATHOLOGY
SAN FRANCISCO, CALIFORNIA 94143

E. SMUCKLER (415) 666-5701 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY
ELECTRON MICROSCOPY

BIOCHEMICAL TESTS: XENOBIOTIC METABOLISM IN THE CYTO-
CHROME P450 SYSTEM

TEST SYSTEMS UTILIZED:

MICE, RATS

COMPOUNDS TESTED:

POLYCHLORINATED HYDROCARBONS (CARBON TETRACHLORIDE,
MONOBROMOTRICHLOROMETHANE, DIBROMOCHLOROPROPANE)

REMARKS:

G. CLAWSON, J. JAMES AND D. MOODY ARE ALSO INVOLVED IN
HEPATOTOXICITY TESTING.

ORGANIZATION:

UNIVERSITY OF KANSAS MEDICAL CENTER
DEPARTMENT OF MEDICINE AND PHARMACOLOGY
KANSAS CITY, KANSAS 66103

C. DUJOVNE (913) 588-7718 (CONTACT)

TESTS PERFORMED:

FUNCTIONAL TESTS: DYE EXCRETION TESTS (ROSE BENGAL
AND INDOCYANINE GREEN)

BIOCHEMICAL TESTS: SERUM ENZYMES (β -GLUCURONIDASE,
LDH*, TRANSAMINASES)

IN VITRO TECHNIQUES: CULTURED HEPATOCYTES
HEPATOMA CELLS

TEST SYSTEMS UTILIZED:

ISOLATED LIVER CELLS OR LIVER CELL CULTURES; RATS, RABBITS,
MICE

COMPOUNDS TESTED:

GENERAL ANAESTHETICS (HALOTHANE, ETHER, CHLORPROMAZINE,
PROMAZINE) ANTIDEPRESSANTS

REMARKS:

STUDIES ARE IN DRUG TRANSPORT AND UPTAKE USING ISOLATED
LIVER CELLS OR LIVER CELL CULTURES.

* Lactic dehydrogenase.

ORGANIZATION:

UNIVERSITY OF KANSAS MEDICAL CENTER
DEPARTMENT OF CLINICAL PHARMACOLOGY AND TOXICOLOGY
KANSAS CITY, KANSAS 66103

C. KLAASSEN (913) 588-7714 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: ELECTRON MICROSCOPY

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
CARBOHYDRATE METABOLISM (LACTATE/PYRUVATE
RATIO)
PROTEIN METABOLISM (UREAGENESIS)
XENOBIOTIC METABOLISM IN THE CYTOCHROME
P450 SYSTEM

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

METALS (CADMIUM, ZINC, COPPER), AMINOPYRENE, CARBON
TETRAHCLORIDE, DIETHYLMALEATE, BROMOBENZENE, HEXABARBITOL

ORGANIZATION:

UNIVERSITY OF MICHIGAN
SCHOOL OF PUBLIC HEALTH
ANN ARBOR, MICHIGAN 48104

M. BRABEC (313)764-4399 (CONTACT)

TESTS PERFORMED:

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
PROTEIN METABOLISM (SYNTHESIS RATE)
LIPID METABOLISM (PEROXIDATION)

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

HALOGENATED HYDROCARBONS (e.g., CARBON TETRACHLORIDE)
UNSATURATED HYDROCARBONS (PROPYLENE, POLYBROMINATED BIPHENYL)

REMARKS:

R. CONOLLY, DEPARTMENT OF ENVIRONMENTAL AND INDUSTRIAL HEALTH,
AND H. CORNISH ARE ALSO INVOLVED IN HEPATOTOXICITY TESTING.

MECHANISMS OF HEPATIC TOXICITY ARE BEING STUDIED BUT TECHNIQUES
COULD BE EASILY ADAPTED FOR A SCREENING PROTOCOL.

ORGANIZATION:

UNIVERSITY OF PITTSBURGH MEDICAL SCHOOL
DEPARTMENT OF PATHOLOGY
PITTSBURGH, PENNSYLVANIA 15261
B. LOMBARDI (412)624-2941 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: ELECTRON MICROSCOPY
HISTOCHEMISTRY

FUNCTIONAL TESTS: RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYMES
PROTEIN METABOLISM
LIPID METABOLISM
VITAMIN METABOLISM
NUCLEIC ACID METABOLISM

TEST SYSTEMS UTILIZED:

SCREENING PROGRAM - RATS
RESEARCH PROGRAM - MICE, RATS, RABBITS

COMPOUNDS TESTED:

CHEMICAL CARCINOGENS (e.g., AROMATIC HYDROCARBONS)

REMARKS:

CHEMICALS TESTED FOR EPA ARE ORGANIC CHEMICALS FOUND IN DRINKING WATER.

BASIC RESEARCH PROGRAM CONCERNS NUTRITIONAL EFFECTS ON LIVER AND PANCREATIC CANCER

ORGANIZATION:

UNIVERSITY OF PITTSBURGH MEDICAL SCHOOL
DEPARTMENT OF PATHOLOGY
PITTSBURGH, PENNSYLVANIA 15261

H. SHINOZUKA (412)624-2444 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

ORGANICS, KNOWN HEPATOTOXIC COMPOUNDS

ORGANIZATION:

UNIVERSITY OF SOUTHERN CALIFORNIA
DEPARTMENT OF PHARMACOLOGY AND NUTRITION
USC SCHOOL OF MEDICINE
2025 ZONAL AVENUE
LOS ANGELES, CALIFORNIA 90033

W. BIDLACK (213)224-7251 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND
HISTOPATHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

FUNCTIONAL TESTS: DYE EXCRETION
BILIRUBIN
RADIOISOTOPIC TECHNIQUES

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
CARBOHYDRATE METABOLISM
LIPID METABOLISM
PROTEIN METABOLISM
XENOBIOTIC METABOLISM
DETOXIFICATION
PRODUCT SYNTHESIS

IN VITRO TECHNIQUES: HEPATOCYTES
HEPATOMA CELLS
ALTERATIONS OF MEMBRANE
FUNCTIONS IN ISOLATED ORGANELLES
(e.g., MICROSOMES, MITOCHONDRIA)

TEST SYSTEMS UTILIZED:

RATS, GUINEA PIGS

COMPOUNDS TESTED:

2-ACETYLAMINOFLUORENE, 2-ACETYL-1-HYDROXYAMINOFLUORINE, CARBON TETRACHLORIDE, ANILINE, p-NITROANISOLE, BENZO(A)PYRENE, NAPHTHALENE, DIMETHYLAMINOAZOBENZENE, AMINOPYRINE, ISONIAZID, CUMENE HYDROPEROXIDE (e.g., MICROSOMES, MITOCHONDRIA)

REMARKS:

P. HOPSTEIN AND A. COHEN ARE ALSO INVOLVED IN HEPATOTOXICITY TESTING.

ORGANIZATION:

UNIVERSITY OF TEXAS, AUSTIN
COLLEGE OF PHARMACY
AUSTIN, TEXAS 78712

D. ACOSTA (512)471-4736 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: HISTOCHEMICAL STAINING
(LISSAMINE GREEN AND TRYPLAN BLUE)

FUNCTIONAL TESTS: DYE EXCRETION TESTS (BSP)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS INCLUDING
ARGININOSUCCINATE LYASE)
CARBOHYDRATE METABOLISM (SUGAR RATIOS)
PROTEIN METABOLISM (PROTEIN LEVELS,
CHANGES IN ATP)
NITROGEN METABOLISM (UREAGENESIS)
XENOBIOTIC METABOLISM IN THE
CYTOCHROME P450 SYSTEM

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

ALCOHOL, CARBON TETRACHLORIDE, CAFFEINE, SODIUM SALISCYLATE,
THERAPEUTIC AGENTS: ACETAMINOPHEN, PAPAVERINE, TETRACYCLINE,
NORETHRINDRONE, NITROFURANTOIN

REMARKS:

THESE IN VITRO METHODS ARE BEING COMPARED WITH THE RESULTS
OF ANIMAL TOXICITY SCREENING STUDIES BY J. BRUCKNER AT THE
UNIVERSITY OF TEXAS.

ORGANIZATION:

UNIVERSITY OF TEXAS MEDICAL SCHOOL
DEPARTMENT OF PHARMACOLOGY
HOUSTON, TEXAS 77025

J. BRUCKNER (713) 792-5977 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: ELECTRON MICROSCOPY

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS
PROTEIN METABOLISM
GLYCOGEN SYNTHESIS, LEVELS OF ATP,
UREAGENESIS
XENOBIOTIC METABOLISM IN THE CYTOCHROME
P450 SYSTEM

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

CHLORINATED HYDROCARBONS (i.e., DDT, PCBs)

REMARKS:

THESE IN VIVO METHODS ARE BEING CORRELATED WITH D. ACOSTA'S
IN VITRO SCREENING TESTS USING PRIMARY HEPATOCYTES AT THE
UNIVERSITY OF TEXAS, AUSTIN. ONE OF THE GOALS IS TO BE ABLE
TO REACH THE SAME RANK ORDER OF TOXICITY OF THE COMPOUNDS
TESTED.

ORGANIZATION:

UNIVERSITY OF TEXAS (UTMB)
DEPARTMENT OF PATHOLOGY
GALVESTON, TEXAS 77550

E. REYNOLDS (713)765-2889 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS:	GROSS OBSERVATION LIGHT MICROSCOPY ELECTRON MICROSCOPY
FUNCTIONAL TESTS:	RADIOISOTOPIC TECHNIQUES
BIOCHEMICAL TESTS:	SERUM ENZYME LEVELS PROTEIN METABOLISM XENOBIOTIC METABOLISM VITAMIN METABOLISM LEVELS OF LIVER METALS AND SERUM ELECTROLYTES DETOXIFICATION PRODUCT SYNTHESIS
<u>IN VITRO</u> TECHNIQUES:	HEPATOCYTES

TEST SYSTEMS UTILIZED:

RATS, MICE

COMPOUNDS TESTED:

KNOWN HEPATOTOXINS

REMARKS:

PRINCIPAL INTEREST IN INVESTIGATING MOLECULAR MECHANISMS OF
CELLULAR INJURY.

ORGANIZATION:

UNIVERSITY OF TORONTO
DEPARTMENT OF PATHOLOGY
TORONTO, ONTARIO, CANADA

E. FARBER (416) 978-2557 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: GROSS OBSERVATION
LIGHT MICROSCOPY

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS (TRANSAMINASES AND
LACTIC DEHYDROGENASE
XENOBIOTIC METABOLISM IN THE CYTOCHROME
P450 SYSTEM

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

A WIDE VARIETY OF COMPOUNDS HAVE BEEN TESTED.

REMARKS:

MOSTLY INVOLVED IN BASIC CANCER INITIATION RESEARCH;
NEVERTHELESS, A FEW SCREENING TECHNIQUES ARE EMPLOYED.

ORGANIZATION:

UNIVERSITY OF WISCONSIN
McCARDLE INSTITUTE
MADISON, WISCONSIN 53705

H. PITOT (608)262-2177 (CONTACT)

TESTS PERFORMED:

MONITORING CARCINOGENIC MECHANISMS IN WHOLE ANIMAL TO
DISTINGUISH BETWEEN COMPLETE CARCINOGENS, CARCINOGENIC
ENHANCERS OR PROMOTERS BY TIMED DOSES

ALSO STUDYING DNA REPAIR IN PRIMARY HEPATOCYTES.

TEST SYSTEMS UTILIZED:

HAMSTERS, MICE, RATS

COMPOUNDS TESTED:

IN VITRO: KNOWN CARCINOGENS (i.e., BUTTER YELLOW)
IN VIVO: PROMOTING (i.e., TCDD) OR INITIATING (i.e.,
PROFLAVIN) AGENTS

REMARKS:

A. SINICA, DEPARTMENT OF ANATOMY, IS WORKING ON DNA REPAIR
AT THIS ORGANIZATION.

ORGANIZATION:

U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUNDS, MARYLAND 21010

A. McCREESH (302)671-3627 (CONTACT)

TESTS PERFORMED:

MORPHOLOGICAL TESTS: ELECTRON MICROSCOPY

FUNCTIONAL TESTS: RADIOISOTOPIC TECHNIQUE (CLEARANCE AFTER
DERMAL EXPOSURE)

BIOCHEMICAL TESTS: SERUM ENZYME LEVELS (SGOT, SGPT, ALP,
LDH, ETC.)
PROTEIN METABOLISM (NITRITES, NITRATES)
LEVELS OF SERUM ELECTROLYTES AND METALS
(Na^+ , Ca^+ , K^+)
DETOXIFICATION
PRODUCT SYNTHESIS (BLOOD METABOLISM)

TEST SYSTEMS UTILIZED:

DOGS, GUINEA PIGS, RABBITS, RATS

COMPOUNDS TESTED:

PROPELLANTS, EXPLOSIVES, PESTICIDES, FUNGICIDES AND
DISINFECTANTS.

ORGANIZATION:

VANDERBILT UNIVERSITY
DEPARTMENT OF BIOCHEMISTRY
NASHVILLE, TENNESSEE 37232

R. A. NEAL (615) 322-2261 (CONTACT)

TEST PERFORMED:

BASIC RESEARCH: MECHANISMS OF HEPATOTOXICITY.

NOT STUDYING SCREENING TESTS OR METHODS.

TEST SYSTEMS UTILIZED:

RATS

COMPOUNDS TESTED:

SULFUR-CONTAINING COMPOUNDS

APPENDIX A
TESTS PERFORMED BY EACH ORGANIZATION

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynamics
Chemical Industry Institute of Toxicology
Dow Chemical USA
Duke Medical Center
Exxon Corporation
Food Research Institute
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Medical College of Virginia
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Naylor Dana Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University
Temple University School of Medicine
The Upjohn Company
Thomas Jefferson University
Union Carbide Corporation
University of Arizona
University of California, Irvine
University of California, San Francisco
University of Pittsburgh Medical School
University of Southern California
University of Texas, Austin
University of Texas Medical School
University of Texas (UTMB)
University of Toronto
U.S. Army Environmental Hygiene Agency

FUNCTIONAL TESTS

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynacs
Chemical Industry Institute of Toxicology
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
Food Research IUstitute
G.D. Searle and Company
George Washington University Hospital
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University School of Medicine
The Upjohn Company
Thomas Jefferson University
Union Carbide Corporation
University of Arizona
University of California, Irvine
University of Kansas Medical Center
University of Pittsburgh Medical School
University of Southern California
University of Texas, Austin
Universty of Texas (UTMB)
U.S. Army Environmental Hygiene Agency

DYE EXCRETION (BSP, ICG, ETC.)

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynamics
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
George Washington University Hospital
Hazleton Laboratories

FUNCTIONAL TESTS (Continued)

Hoffman LaRoche Incorporated
Litton Bionetics Incorporated
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
Temple University School of Medicine
Thomas Jefferson University
Union Carbide Corporation
University of Kansas Medical Center
University of Southern California
University of Texas, Austin

BILIRUBIN (SERUM URINE,
UROBILINOGEN LEVELS:
BILIARY TRANSPORT MAXIMUM)

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynamics
Chemical Industry Institute of Toxicology
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University School of Medicine
The Upjohn Company
University of Southern California

FUNCTIONAL TESTS (Continued)

RADIOISOTOPIC TECHNIQUES

Albert Einstein College of Medicine
Bio-Dynamics
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University School of Medicine
Thomas Jefferson University
University of California, Irvine
University of Pittsburgh Medical School
University of Southern California
University of Texas (UTMB)
U.S. Army Environmental Hygiene Agency

MEMBRANE INTEGRITY

Food Research Institute
Thomas Jefferson University
University of Arizona

BIOCHEMICAL TESTS

Abbott Laboratories
Albert Einstein College of Medicine
Baylor College of Medicine
Bio-Dynamics
Chemical Industry Institute of Toxicology
Dow Chemical USA
Duke Medical Center
Exxon Corporation
Food and Drug Research Laboratories
Food Research Institute
G.D. Searle and Company
George Washington University Hospital
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Medical College of Virginia
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Naylor Dana Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University
Temple University School of Medicine
The Upjohn Company
Thomas Jefferson University
Union Carbide Corporation
University of Arizona
University of California, Irvine
University of California, San Francisco
University of Kansas Medical Center
University of Michigan
University of Pittsburgh Medical School
University of Southern California
University of Texas, Austin
University of Texas Medical School
University of Texas (UTMB)
University of Toronto
U.S. Army Environmental Hygiene Agency

BIOCHEMICAL TESTS (Continued)

SERUM ENZYME LEVELS
(SCOT, SCPT, ALP, ETC.)

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynamics
Chemical Industry Institute of Toxicology
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
George Washington University Hospital
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Medical College of Virginia
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University School of Medicine
The Upjohn Company
Thomas Jefferson University
University of Arizona
University of Kansas Medical Center
University of Michigan
University of Pittsburgh Medical School
University of Southern California
University of Texas, Austin
University of Texas Medical School
University of Texas (UTMB)
University of Toronto
U.S. Army Environmental Hygiene Agency

CARBOHYDRATE METABOLISM
(e.g. GLUCOSE LEVELS)

Abbott Laboratories
Bio-Dynamics
Chemical Industry Institute of Toxicology
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated

BIOCHEMICAL TESTS (Continued)

International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Medical College of Virginia
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
The Upjohn Company
University of Kansas Medical Center
University of Southern California
University of Texas, Austin

LIPID METABOLISM (PLASMA
OR SERUM CHOLESTEROL LEVELS)

Abbott Laboratories
Albert Einstein College of Medicine
Baylor College of Medicine
Bio-Dynamics
Chemical Industry Institute of Toxicology
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Medical College of Virginia
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
Temple University
The Upjohn Company
University of Michigan
University of Pittsburgh Medical School

PROTEIN METABOLISM (BUN UREAGENESIS,
SERUM PROTEIN LEVELS, i.e., ALBUMIN
GLOBULIN LEVELS, ELECTROPHORESIS)

Abbott Laboratories
Albert Einstein College of Medicine

BIOCHEMICAL TESTS (Continued)

Bio-Dynamics
Chemical Industry Institute of Toxicology
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Medical College of Virginia
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
The Upjohn Company
Thomas Jefferson University
University of Arizona
University of Kansas Medical Center
University of Michigan
University of Pittsburgh Medical School
University of Southern California
University of Texas, Austin
University of Texas Medical School
University of Texas (UTMB)
U.S. Army Environmental Hygiene Agency

NITROGEN METABOLISM (UREAGENESIS)

Dow Chemical USA
Hoffman LaRoche Incorporated
University of Texas, Austin

XENOBIOTIC METABOLISM

Albert Einstein College of Medicine
Baylor College of Medicine
Bio-Dynamics
Dow Chemical USA
Duke Medical Center
Food Research Institute
G.D. Searle and Company
George Washington University Hospital
Litton Bionetics Incorporated

BIOCHEMICAL TESTS (Continued)

Medical College of Virginia
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Naylor Dana Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University
Temple University School of Medicine
Thomas Jefferson University
Union Carbide Corporation
University of Arizona
University of California, Irvine
University of California, San Francisco
University of Kansas Medical Center
University of Southern California
University of Texas, Austin
University of Texas Medical School
University of Texas (UTMB)
University of Toronto

DRUG METABOLISM

Food Research Institute
Massachusetts Institute of Technology
Midwest Research Institute
Temple University School of Medicine
The Upjohn Company

VITAMIN METABOLISM

Abbott Laboratories
Bio-Dynamics
Food and Drug Research Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Midwest Research Institute
Rutgers Medical School (CMDNJ)
The Upjohn Company
University of Pittsburgh Medical School
University of Texas (UTMB)

LEVELS OF SERUM METALS AND ELECTROLYTES
(HEAVY METALS, NA, K, CL⁻)

Abbott Laboratories

BIOCHEMICAL TESTS (Continued)

Albert Einstein College of Medicine
Bio-Dynamics
Chemical Industry Institute of Toxicology
Food and Drug Research Laboratories
G.D. Searle and Company
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Sterling Winthrop Research Institute
Temple University School of Medicine
The Upjohn Company
Union Carbide Corporation
University of Texas (UTMB)
U.S. Army Environmental Hygiene Agency

LEVELS OF TISSUE LIVER METALS

Massachusetts Institute of Technology

VITAMIN ASSAYS

Massachusetts Institute of Technology

TISSUE ENZYME LEVELS

Massachusetts Institute of Technology
Thomas Jefferson University

DETOXIFICATION AND PRODUCT SYNTHESIS

Bio-Dynamics
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Naylor Dana Institute
Sterling Winthrop Research Institute

IN VITRO TECHNIQUES

Albert Einstein College of Medicine
Chemical Industry Institute of Toxicology
Dow Chemical USA
Food Research Institute
George Washington University Hospital
Medical College of Virginia
Midwest Research Institute
Naylor Dana Institute
Rutgers Medical School (CMDNJ)
Thomas Jefferson University
University of Arizona
University of Kansas Medical Center
University of Southern California
University of Texas (UTMB)

PERFUSED LIVER

Albert Einstein College of Medicine
George Washington University Hospital

HEPATOCYTES

Albert Einstein College of Medicine
Chemical Industry Institute of Toxicology
Dow Chemical USA
Food Research Institute
George Washington University Hospital
Medical College of Virginia
Midwest Research Institute
Thomas Jefferson University
University of Arizona
University of Kansas Medical Center
University of Southern California
University of Texas (UTMB)

HEPATOMA CELLS

Albert Einstein College of Medicine
Food Research Institute
Midwest Research Institute
Rutgers Medical School (CMDNJ)

IN VITRO TECHNIQUES (Continued)

University of Arizona
University of Kansas Medical Center
University of Southern California

MEMBRANE INTEGRITY

Albert Einstein College of Medicine

CELL NECROSIS

Naylor Dana Institute

DNA DAMAGE

Chemical Industry Institute of Toxicology
Naylor Dana Institute

MUTAGENESIS

Naylor Dana Institute

ALTERATIONS OF MEMBRANE FUNCTIONS IN ISOLATED ORGANELLES

University of Southern California

APPENDIX B
TEST SYSTEMS UTILIZED BY EACH ORGANIZATION

CATS

Food and Drug Research Laboratories

FUNCTIONAL TESTS

Dye Excretion

Food and Drug Research Laboratories

Bilirubin

Food and Drug Research Laboratories

BIOCHEMICAL TESTS

Serum Enzyme Levels

Food and Drug Research Laboratories

Carbohydrate Metabolism

Food and Drug Research Laboratories

Lipid Metabolism

Food and Drug Research Laboratories

Protein Metabolism

Food and Drug Research Laboratories

Vitamin Metabolism

Food and Drug Research Laboratories

Levels of Serum Metals and Electrolytes

Food and Drug Research Laboratories

Detoxification and Synthesis

Food and Drug Research Laboratories

CHICKENS

International Research and Development Corporation

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

International Research and Development Corporation

FUNCTIONAL TESTS

Bilirubin

International Research and Development Corporation

BIOCHEMICAL TESTS

Serum Enzyme Levels

International Research and Development Corporation

Carbohydrate Metabolism

International Research and Development Corporation

Lipid Metabolism

International Research and Development Corporation

Protein Metabolism

International Research and Development Corporation

Vitamin Metabolism

International Research and Development Corporation

Levels of Serum Metals and Electrolytes

International Research and Development Corporation

Detoxification and Synthesis

International Research and Development Corporation

DOGS

Abbott Laboratories
Bio-Dynamics
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
The Upjohn Company
Union Carbide Corporation
University of California
U.S. Army Environmental Hygiene Agency

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Abbott Laboratories
Bio-Dynamics
Dow Chemical USA
Exxon Corporation
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
The Upjohn Company
Union Carbide Corporation
U.S. Army Environmental Hygiene Agency

DOGS (Continued)

FUNCTIONAL TESTS

Dye Excretion

Abbott Laboratories
Bio-Dynamics
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
Litton Bionetics Incorporated
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
Union Carbide Corporation

Bilirubin

Abbott Laboratories
Bio-Dynamics
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
The Upjohn Company

Radioisotopic Techniques

Bio-Dynamics
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Science

DOGS (Continued)

FUNCTIONAL TESTS (Continued)

Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
U.S. Army Environmental Hygiene Agency

BIOCHEMICAL TESTS

Serum Enzyme Levels

Abbott Laboratories
Bio-Dynamics
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
The Upjohn Company
University of California
U.S. Army Environmental Hygiene Agency

Carbohydrate Metabolism

Abbott Laboratories
Bio-Dynamics
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
The Upjohn Company

Lipid Metabolism

Abbott Laboratories
Bio-Dynamics

DOGS (Continued)

BIOCHEMICAL TESTS (Continued)

Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
The Upjohn Company

Protein Metabolism

Abbott Laboratories
Bio-Dynamics
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
The Upjohn Company
U.S. Army Environmental Hygiene Agency

Nitrogen Metabolism

Dow Chemical USA
Hoffman LaRoche Incorporated

DOGS (Continued)

BIOCHEMICAL TESTS (Continued)

Xenobiotic Metabolism

Dow Chemical USA
G.D. Searle and Company
Litton Bionetics Incorporated
Midwest Research Institute
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Union Carbide Corporation

Drug Metabolism

Massachusetts Institute of Technology
Midwest Research Institute
The Upjohn Company

Vitamin Metabolism

Abbott Laboratories
Bio-Dynamics
Food and Drug Research Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Midwest Research Institute
Rutgers Medical School (CMDNJ)
The Upjohn Company

Levels of Serum Metals and Electrolytes

Abbott Laboratories
Bio-Dynamics
Food and Drug Research Laboratories
G.D. Searle and Company
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Sterling Winthrop Research Institute
The Upjohn Company
Union Carbide Corporation
U.S. Army Environmental Hygiene Agency

DOGS (Concluded)

BIOCHEMICAL TESTS (Concluded)

Levels of Tissue Liver Metals

Massachusetts Institute of Technology

Vitamin Assays

Massachusetts Institute of Technology

Tissue Enzyme Levels

Massachusetts Institute of Technology

Detoxification and Product Synthesis

Bio-Dynamics

Exxon Corporation

Food and Drug Research Laboratories

G.D. Searle and Company

Hazleton Laboratories

International Research and Development Corporation

Massachusetts Institute of Technology

Midwest Research Institute

Monsanto Company

National Institute of Environmental Health Sciences

Sterling Winthrop Research Institute

U.S. Army Environmental Hygiene Agency

IN VITRO TECHNIQUES

Hepatocytes

Dow Chemical USA

Midwest Research Institute

Hepatoma Cells

Midwest Research Institute

Rutgers Medical School (CMDNJ)

FISH

Albert Einstein College of Medicine

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Albert Einstein College of Medicine

FUNCTIONAL TESTS

Dye Excretion

Albert Einstein College of Medicine

Bilirubin

Albert Einstein College of Medicine

Radioisotopic Techniques

Albert Einstein College of Medicine

BIOCHEMICAL TESTS

Serum Enzyme Levels

Albert Einstein College of Medicine

Lipid Metabolism

Albert Einstein College of Medicine

Protein Metabolism

Albert Einstein College of Medicine

Xenobiotic Metabolism

Albert Einstein College of Medicine

Levels of Serum Metals and Electrolytes

Albert Einstein College of Medicine

IN VITRO TECHNIQUES

Isolated Perfused Liver

Albert Einstein College of Medicine

FISH (Concluded)

IN VITRO TECHNIQUES (Concluded)

Hepatocytes and Hepatoma Cells

Albert Einstein College of Medicine

Membrane Integrity

Albert Einstein College of Medicine

GOATS

Albert Einstein College of Medicine

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Albert Einstein College of Medicine

FUNCTIONAL TESTS

Dye Excretion

Albert Einstein College of Medicine

Bilirubin

Albert Einstein College of Medicine

Radioisotopic Techniques

Albert Einstein College of Medicine

BIOCHEMICAL TESTS

Serum Enzyme Levels

Albert Einstein College of Medicine

Lipid Metabolism

Albert Einstein College of Medicine

Protein Metabolism

Albert Einstein College of Medicine

GOATS (Concluded)

BIOCHEMICAL TESTS (Concluded)

Xenobiotic Metabolism

Albert Einstein College of Medicine

Levels of Serum Metals and Electrolytes

Albert Einstein College of Medicine

IN VITRO TECHNIQUES

Isolated Perfused Liver

Albert Einstein College of Medicine

Hepatocytes and Hepatoma Cells

Albert Einstein College of Medicine

Membrane Integrity

Albert Einstein College of Medicine

GUINEA PIGS

Bio-Dynamics

Food and Drug Research Laboratories

Hazleton Laboratories

Hoffman LaRoche Incorporated

International Research and Development Corporation

Massachusetts Institute of Technology

Midwest Research Institute

Sterling Winthrop Research Institute

University of Southern California

U.S. Army Environmental Hygiene Agency

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Bio-Dynamics

Hazleton Laboratories

Hoffman LaRoche Incorporated

International Research and Development Corporation

Massachusetts Institute of Technology

Midwest Research Institute

Sterling Winthrop Research Institute

University of Southern California

U.S. Army Environmental Hygiene Agency

GUINEA PIGS (Continued)

FUNCTIONAL TESTS

Dye Excretion

Bio-Dynamics
Food and Drug Research Laboratories
Hazleton Laboratories
Hoffman LaRoche Incorporated
Midwest Research Institute
University of Southern California

Bilirubin

Bio-Dynamics
Food and Drug Research Laboratories
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Sterling Winthrop Research Institute
University of Southern California

Radiosotopic Techniques

Bio-Dynamics
Massachusetts Institute of Technology
Midwest Research Institute
University of Southern California
U.S. Army Environmental Hygiene Agency

BIOCHEMICAL TESTS

Serum Enzyme Levels

Bio-Dynamics
Food and Drug Research Laboratories
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Midwest Research Institute
Sterling Winthrop Research Institute
University of Southern California
U.S. Army Environmental Hygiene Agency

GUINEA PIGS (Continued)

BIOCHEMICAL TESTS (Continued)

Carbohydrate Metabolism

Bio-Dynamics
Food and Drug Research Laboratories
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Midwest Research Institute
University of Southern California

Lipid Metabolism

Bio-Dynamics
Food and Drug Research Laboratories
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
University of Southern California

Protein Metabolism

Bio-Dynamics
Food and Drug Research Laboratories
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
University of Southern California
U.S. Army Environmental Hygiene Agency

Nitrogen Metabolism

Hoffman LaRoche Incorporated

Xenobiotic Metabolism

Bio-Dynamics
Midwest Research Institute
University of Southern California

GUINEA PIGS (Continued)

BIOCHEMICAL TESTS (Continued)

Drug Metabolism

Massachusetts Institute of Technology
Midwest Research Institute

Vitamin Metabolism

Bio-Dynamics
Food and Drug Research Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Midwest Research Institute

Levels of Serum Metals and Electrolytes

Bio-Dynamics
Food and Drug Research Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Sterling Winthrop Research Institute

Levels of Tissue Liver Metals

Massachusetts Institute of Technology

Vitamin Assays

Massachusetts Institute of Technology

Alterations of Membrane Functions in Isolated Organelles

University of Southern California

Tissue Enzyme Levels

Massachusetts Institute of Technology

Detoxification and Product Synthesis

Bio-Dynamics
Food and Drug Research Laboratories

GUINEA PIGS (Concluded)

BIOCHEMICAL TESTS (Concluded)

Hazleton Laboratories
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
University of Southern California
U.S. Army Environmental Hygiene Agency

IN VITRO TECHNIQUES

Hepatocytes

Midwest Research Institute
University of Southern California

Hepatoma Cells

Midwest Research Institute
University of Southern California

HAMSTERS

Bio-Dynamics
Food and Drug Research Laboratories
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Naylor Dana Institute
Sterling Winthrop Research Institute
Thomas Jefferson University
University of California, Irvine

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Bio-Dynamics
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Naylor Dana Institute
Sterling Winthrop Research Institute
Thomas Jefferson University
University of California, Irvine

HAMSTERS (Continued)

FUNCTIONAL TESTS (Concluded)

Dye Excretion

Bio-Dynamics
Food and Drug Research Laboratories
Midwest Research Institute
Monsanto Company
Thomas Jefferson University

Bilirubin

Bio-Dynamics
Food and Drug Research Laboratories
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Sterling Winthrop Research Institute

Radioisotopic Techniques

Bio-Dynamics
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Thomas Jefferson University
University of California, Irvine

Membrane Integrity

Thomas Jefferson University

BIOCHEMICAL TESTS

Serum Enzyme Levels

Bio-Dynamics
Food and Drug Research Laboratories
International Research and Development Corporation
Midwest Research Institute
Monsanto Company
Sterling Winthrop Research Institute

HAMSTERS (Continued)

BIOCHEMICAL TESTS (Continued)

Carbohydrate Metabolism

Bio-Dynamics
Food and Drug Research Laboratories
International Research and Development Corporation
Midwest Research Institute
Monsanto Company

Lipid Metabolism

Bio-Dynamics
Food and Drug Research Laboratories
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company

Protein Metabolism

Bio-Dynamics
Food and Drug Research Laboratories
International Research Institute
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Thomas Jefferson University

Xenobiotic Metabolism

Bio-Dynamics
Midwest Research Institute
Naylor Dana Institute
Thomas Jefferson University
University of California, Irvine

Drug Metabolism

Massachusetts Institute of Technology
Midwest Research Institute

HAMSTERS (Continued)

BIOCHEMICAL TESTS (Concluded)

Vitamin Metabolism

Bio-Dynamics
Food and Drug Research Laboratories
International Research and Development Corporation
Midwest Research Institute

Levels of Serum Metals and Electrolytes

Bio-Dynamics
Food and Drug Research Laboratories
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Sterling Winthrop Research Institute

Levels of Tissue Liver Metals

Massachusetts Institute of Technology

Vitamin Assays

Massachusetts Institute of Technology

Tissue Enzyme Levels

Massachusetts Institute of Technology
Thomas Jefferson University

Detoxification and Product Synthesis

Bio-Dynamics
Food and Drug Research Laboratories
International Research and Development Institute
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Naylor Dana Institute
Thomas Jefferson University
University of California, Irvine

HAMPSTERS (Concluded)

IN VITRO TECHNIQUES

Hepatocytes

Midwest Research Institute
Thomas Jefferson University

Hepatoma Cells

Midwest Research Institute

Cell Necrosis

Naylor Dana Institute

DNA Damage

Naylor Dana Institute

Mutagenesis

Naylor Dana Institute

HUMANS

Duke Medical Center
Food and Drug Research Laboratories
Sterling Winthrop Research Institute

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Duke Medical Center

FUNCTIONAL TESTS

Dye Excretion

Food and Drug Research Laboratories

Bilirubin

Food and Drug Research Laboratories

Radioisotopic Techniques

Sterling Winthrop Research Institute

HUMANS (Concluded)

BIOCHEMICAL TESTS

Serum Enzyme Levels

Food and Drug Research Laboratories

Carbohydrate Metabolism

Food and Drug Research Laboratories

Lipid Metabolism

Food and Drug Research Laboratories

Protein Metabolism

Food and Drug Research Laboratories

Xenobiotic Metabolism

Duke Medical Center
Sterling Winthrop Research Institute

Vitamin Metabolism

Food and Drug Research Laboratories

Levels of Serum Metals and Electrolytes

Food and Drug Research Laboratories

Detoxification and Product Synthesis

Food and Drug Research Laboratories
Sterling Winthrop Research Institute

IN VITRO TECHNIQUES

DNA Damage

Duke Medical Center

MICE

Abbott Laboratories
Albert Einstein College of Medicine
American Health Foundation
Baylor College of Medicine
Bio-Dynamics
Chemical Industry Institute of Toxicology
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Massachusetts Institute of Technology
Midwest Research Institute
National Institute of Environmental Health Sciences
Naylor Dana Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University School of Medicine
The Upjohn Company
Thomas Jefferson University
Union Carbide Corporation
University of Arizona
University of California, Irvine
University of California, San Francisco
University of Kansas Medical Center
University of Pittsburgh Medical School
University of Texas (UTMB)

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynamics
Chemical Industry Institute of Toxicology
Dow Chemical USA
Exxon Corporation
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Massachusetts Institute of Technology
Midwest Research Institute
National Institute of Environmental Health Sciences
Naylor Dana Institute
Rutgers Medical School (CMDNJ)

MICE (Continued)

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS (Concluded)

Sterling Winthrop Research Institute
Temple University School of Medicine
The Upjohn Company
Thomas Jefferson University
University of Arizona
University of California, Irvine
Union Carbide Corporation
University of California, San Francisco
University of Pittsburgh Medical School
University of Texas (UTMB)

FUNCTIONAL TESTS

Dye Excretion

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynamics
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
Litton Bionetics Incorporated
Midwest Research Institute
Rutgers Medical School (CMDNJ)
Temple University School of Medicine
Thomas Jefferson University
Union Carbide Corporation
University of Kansas Medical Center

Bilirubin

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynamics
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories

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EVALUATION OF SHORT-TERM BIOASSAYS TO PREDICT FUNCTIONAL IMPAIRMENT—ETC(U)
OCT BU P GREENAWAY, J KONZ, R THOMAS
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WP-79W00223

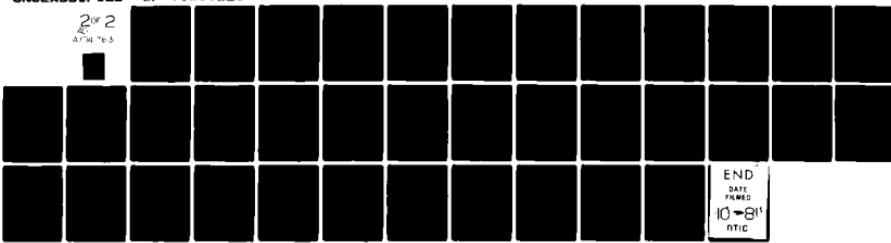
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MICE (Continued)

FUNCTIONAL TESTS (Concluded)

Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Massachusetts Institute of Technology
Midwest Research Institute
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University School of Medicine
The Upjohn Company

Radioisotopic Techniques

Albert Einstein College of Medicine
Bio-Dynamics
Massachusetts Institute of Technology
Midwest Research Institute
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
Temple University School of Medicine
Thomas Jefferson University
University of California, Irvine
University of Pittsburgh Medical School
University of Texas (UTMB)

Membrane Integrity

Thomas Jefferson University
University of Arizona

BIOCHEMICAL TESTS

Serum Enzyme Levels

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynamics
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Midwest Research Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute

MICE (Continued)

BIOCHEMICAL TESTS (Continued)

Temple University School of Medicine
The Upjohn Company
University of Arizona
University of Kansas Medical Center
University of Pittsburgh Medical School
University of Texas (UTMB)

Carbohydrate Metabolism

Abbott Laboratories
Bio-Dynamics
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Midwest Research Institute
Rutgers Medical School (CMDNJ)
The Upjohn Company

Lipid Metabolism

Albert Einstein College of Medicine
Baylor College of Medicine
Bio-Dynamics
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Massachusetts Institute of Technology
Midwest Research Institute
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
The Upjohn Compnay
University of Pittsburgh Medical School

MICE (Continued)

BIOCHEMICAL TESTS (Continued)

Protein Metabolism

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynamics
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Massachusetts Institute of Technology
Midwest Research Institute
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
The Upjohn Company
Thomas Jefferson University
University of Arizona
University of Pittsburgh Medical School
University of Texas (UTMB)

Nitrogen Metabolism

Dow Chemical
Hoffman LaRoche Incorporated

Xenobiotic Metabolism

Albert Einstein College of Medicine
Baylor College of Medicine
Bio-Dynamics
Dow Chemical USA
G.D. Searle and Company
Litton Bionetics Incorporated
Midwest Research Institute
National Institute of Environmental Health Sciences
Naylor Dana Institute
Rutgers Medical School (CMDNJ)
Temple University School of Medicine
Thomas Jefferson University
Union Carbide Corporation
University of Arizona
University of California, Irvine

MICE (Continued)

BIOCHEMICAL TESTS (Continued)

University of California, San Francisco
University of Texas (UTMB)

Drug Metabolism

Massachusetts Institute of Technology
Midwest Research Institute
Temple University School of Medicine
The Upjohn Company

Vitamin Metabolism

Abbott Laboratories
Bio-Dynamics
Food and Drug Research Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Midwest Research Institute
Rutgers Medical School (CMDNJ)
The Upjohn Company
University of Pittsburgh Medical School
University of Texas (UTMB)

Levels of Serum Metals and Electrolytes

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynamics
Food and Drug Research Laboratories
G.D. Searle and Company
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Massachusetts Institute of Technology
Midwest Research Institute
Sterling Winthrop Research Institute
Temple University School of Medicine
The Upjohn Company
Union Carbide Corporation
University of Texas (UTMB)

Levels of Tissue Liver Metals

Massachusetts Institute of Technology

MICE (Continued)

BIOCHEMICAL TESTS (Concluded)

Vitamin Assays

Massachusetts Institute of Technology

Tissue Enzyme Levels

Massachusetts Institute of Technology
Thomas Jefferson University

Detoxification and Product Synthesis

Bio-Dynamics

Exxon Corporation

Food and Drug Research Laboratories

G.D. Searle and Company

Hazleton Laboratories

International Research and Development Corporation

Massachusetts Institute of Technology

Midwest Research Institute

National Institute of Environmental Health Sciences

Naylor Dana Institute

Temple University School of Medicine

Thomas Jefferson University

University of Arizona

University of California, Irvine

University of Texas (UTMB)

IN VITRO TECHNIQUES

Isolated Perfused Liver

Albert Einstein College of Medicine

Hepatocytes

Albert Einstein College of Medicine

Dow Chemical USA

Midwest Research Institute

Thomas Jefferson University

University of Arizona

University of Kansas Medical Center

University of Texas (UTMB)

MICE (Concluded)

IN VITRO TECHNIQUES (Concluded)

Hepatoma Cells

Albert Einstein College of Medicine
Midwest Research Institute
Rutgers Medical School (CMDNJ)
University of Arizona
University of Kansas Medical Center

Membrane Integrity

Albert Einstein College of Medicine

Cell Necrosis

Naylor Dana Institute

DNA Damage

Naylor Dana Institute

Mutagenesis

Naylor Dana Institute

MONKEYS

Abbott Laboratories
Bio-Dynamics
Dow Chemical USA
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
The Upjohn Company

MONKEYS (Continued)

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Abbott Laboratories
Bio-Dynamics
Dow Chemical USA
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Massachusetts Institute of Technology
Midwest Research Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
The Upjohn Company

FUNCTIONAL TESTS

Dye Excretion

Abbott Laboratories
Bio-Dynamics
Dow Chemical USA
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
Litton Bionetics Incorporated
Midwest Research Institute
Rutgers Medical School (CMDNJ)

Bilirubin

Abbott Laboratories
Bio-Dynamics
Dow Chemical USA
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Massachusetts Institute of Technology
Midwest Research Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
The Upjohn Company

MONKEYS (Continued)

BIOCHEMICAL TESTS (Continued)

Dow Chemical USA
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Massachusetts Institute of Technology
Midwest Research Institute
Rutgers Medical School (CMDNJ)
The Upjohn Company

Protein Metabolism

Abbott Laboratories
Bio-Dynamics
Dow Chemical USA
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Massachusetts Institute of Technology
Midwest Research Institute
Rutgers Medical School (CMDNJ)
The Upjohn Company

Nitrogen Metabolism

Dow Chemical USA
Hoffman LaRoche Incorporated

Xenobiotic Metabolism

Bio-Dynamics
Dow Chemical USA
G.D. Searle and Company
Litton Bionetics Incorporated
Midwest Research Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute

MONKEYS (Continued)

FUNCTIONAL TESTS (Concluded)

Radioisotopic Techniques

Bio-Dynamics
Massachusetts Institute of Technology
Midwest Research Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute

BIOCHEMICAL TESTS

Serum Enzyme Levels

Abbott Laboratories
Bio-Dynamics
Dow Chemical USA
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Midwest Research Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
The Upjohn Company

Carbohydrate Metabolism

Abbott Laboratories
Bio-Dynamics
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Midwest Research Institute
Rutgers Medical School (CMDNJ)
The Upjohn Company

Lipid Metabolism

Abbott Laboratories
Bio-Dynamics

MONKEYS (Continued)

BIOCHEMICAL TESTS (Continued)

Drug Metabolism

Massachusetts Institute of Technology
Midwest Research Institute
The Upjohn Company

Vitamin Metabolism

Abbott Laboratories
Bio-Dynamics
Food and Drug Research Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Midwest Research Institute
Rutgers Medical School (CMDNJ)
The Upjohn Company

Levels of Serum Metals and Electrolytes

Abbott Laboratories
Bio-Dynamics
Food and Drug Research Laboratories
G.D. Searle and Company
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
Massachusetts Institute of Technology
Midwest Research Institute
Sterling Winthrop Research Institute
The Upjohn Company

Levels of Tissue Liver Metals

Massachusetts Institute of Technology

Vitamin Assays

Massachusetts Institute of Technology

Tissue Enzyme Levels

Massachusetts Institute of Technology

MONKEYS (Concluded)

BIOCHEMICAL TESTS (Concluded)

Detoxification and Product Synthesis

Bio-Dynamics

Food and Drug Research Laboratories

G.D. Searle and Company

Hazleton Laboratories

International Research and Development Corporation

Massachusetts Institute of Technology

Midwest Research Institute

Sterling Winthrop Research Institute

IN VITRO TECHNIQUES

Hepatocytes

Dow Chemical USA

Midwest Research Institute

Hepatoma Cells

Midwest Research Institute

Rutgers Medical School

PIGS

Food and Drug Research Laboratories

International Research and Development Corporation

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

International Research and Development Corporation

FUNCTIONAL TESTS

Dye Excretion

Food and Drug Research Laboratories

Bilirubin

Food and Drug Research Laboratories

International Research and Development Corporation

PIGS (Concluded)

BIOCHEMICAL TESTS

Serum Enzyme Levels

Food and Drug Research Laboratories
International Research and Development Corporation

Carbohydrate Metabolism

Food and Drug Research Laboratories
International Research and Development Corporation

Lipid Metabolism

Food and Drug Research Laboratories
International Research and Development Corporation

Protein Metabolism

Food and Drug Research Laboratories
International Research and Development Corporation

Levels of Serum Metals and Electrolytes

Food and Drug Research Laboratories
International Research and Development Corporation

Detoxification and Product Synthesis

Food and Drug Research Laboratories
International Research and Development Corporation

Vitamin Metabolism

Food and Drug Research Laboratories
International Research and Development Corporation

RABBITS

Albert Einstein College of Medicine
American Health Foundation
Bio-Dynamics
Exxon Corporation
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation

RABBITS (Continued)

Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Naylor Dana Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Thomas Jefferson University
University of Kansas Medical Center
University of Pittsburgh Medical School
U.S. Army Environmental Hygiene Agency

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Albert Einstein College of Medicine
Bio-Dynamics
Exxon Corporation
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Naylor Dana Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Thomas Jefferson University
University of Pittsburgh Medical School
U.S. Army Environmental Hygiene Agency

FUNCTIONAL TESTS

Dye Excretion

Albert Einstein College of Medicine
Bio-Dynamics
Exxon Corporation
Hazleton Laboratories
Hoffman LaRoche Incorporated
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
Thomas Jefferson University
University of Kansas Medical Center

RABBITS (Continued)

FUNCTIONAL TESTS (Concluded)

Bilirubin

Albert Einstein College of Medicine
Bio-Dynamics
Exxon Corporation
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute

Radioisotopic Techniques

Albert Einstein College of Medicine
Bio-Dynamics
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
Thomas Jefferson University
University of Pittsburgh Medical School
U.S. Army Environmental Hygiene Agency

Membrane Integrity

Thomas Jefferson University

BIOCHEMICAL TESTS

Serum Enzyme Levels

Albert Einstein College of Medicine
Bio-Dynamics
Exxon Corporation
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute

RABBITS (Continued)

BIOCHEMICAL TESTS (Continued)

University of Kansas Medical Center
University of Pittsburgh Medical School
U.S. Army Environmental Hygiene Agency

Carbohydrate Metabolism

Bio-Dynamics
Exxon Corporation
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)

Lipid Metabolism

Albert Einstein College of Medicine
Bio-Dynamics
Exxon Corporation
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
University of Pittsburgh Medical School

Protein Metabolism

Albert Einstein College of Medicine
Bio-Dynamics
Exxon Corporation
Food and Drug Research Laboratories
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
Thomas Jefferson University

RABBITS (Continued)

BIOCHEMICAL TESTS (Continued)

University of Pittsburgh Medical School
U.S. Army Environmental Hygiene Agency

Nitrogen Metabolism

Hoffman LaRoche Incorporated

Xenobiotic Metabolism

Albert Einstein College of Medicine
Midwest Research Institute
Naylor Dana Institute
Rutgers Medical School (CMDNJ)
Thomas Jefferson University

Drug Metabolism

Massachusetts Institute of Technology
Midwest Research Institute

Vitamin Metabolism

Bio-Dynamics
Hoffman LaRoche Incorporated
International Research and Development Corporation
Midwest Research Institute
Rutgers Medical School (CMDNJ)
University of Pittsburgh Medical School

Levels of Serum Metals and Electrolytes

Albert Einstein College of Medicine
Bio-Dynamics
Hoffman LaRoche Incorporated
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Sterling Winthrop Research Institute
U.S. Army Environmental Hygiene Agency

RABBITS (Continued)

BIOCHEMICAL TESTS (Concluded)

Levels of Tissue Liver Metals

Massachusetts Institute of Technology

Vitamin Assays

International Research and Development Corporation
Massachusetts Institute of Technology

Tissue Enzyme Levels

Massachusetts Institute of Technology
Thomas Jefferson University

Detoxification and Synthesis

Bio-Dynamics
Exxon Corporation
Hazleton Laboratories
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Naylor Dana Institute
Thomas Jefferson University
U.S. Army Environmental Hygiene Agency

IN VITRO TECHNIQUES

Isolated Perfused Liver

Albert Einstein College of Medicine

Hepatocytes

Albert Einstein College of Medicine
Midwest Research Institute
Thomas Jefferson University
University of Kansas Medical Center

Hepatoma Cells

Albert Einstein College of Medicine
Midwest Research Institute

RABBITS (Concluded)

IN VITRO TECHNIQUES (Concluded)

Rutgers Medical School (CMDNJ)
University of Kansas Medical Center

Membrane Integrity

Albert Einstein College of Medicine

Cell Necrosis

Naylor Dana Institute

DNA Damage

Naylor Dana Institute

Mutagenesis

Naylor Dana Institute

RATS

Abbott Laboratories

Albert Einstein College of Medicine

American Health Foundation

Baylor College of Medicine

Bio-Dynamics

Chemical Industry Institute of Toxicology

Dow Chemical USA

Duke Medical Center

Exxon Corporation

Food and Drug Research Laboratories

Food Research Institute

G.D. Searle and Company

George Washington University Hospital

Hazleton Laboratories

Hoffman LaRoche Incorporated

International Research and Development Corporation

Litton Bionetics Incorporated

3M-Riker Laboratories

Medical College of Virginia

Massachusetts Institute of Technology

Midwest Research Institute

Monsanto Company

National Institute of Environmental Health Sciences

RATS (Continued)

Naylor Dana Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University
Temple University School of Medicine
The Upjohn Company
Thomas Jefferson University
Union Carbide Corporation
University of Arizona
University of California, Irvine
University of California, San Francisco
University of Kansas Medical Center
University of Michigan
University of Pittsburgh Medical School
University of Southern California
University of Texas, Austin
University of Texas Medical School
University of Texas (UTMB)
University of Toronto
U.S. Army Environmental Hygiene Agency

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynamics
Chemical Industry Institute of Toxicology
Dow Chemical USA
Duke Medical Center
Exxon Corporation
Food Research Institute
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Medical College of Virginia
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Naylor Dana Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University

RATS (Continued)

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Temple University School of Medicine
The Upjohn Company
Thomas Jefferson University
Union Carbide Corporation
University of Arizona
University of California, Irvine
University of California, San Francisco
University of Kansas Medical Center
University of Pittsburgh Medical School
University of Southern California
University of Texas, Austin
University of Texas Medical School
University of Texas (UTMB)
University of Toronto
U.S. Army Environmental Hygiene Agency

FUNCTIONAL TESTS

Dye Excretion

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynamics
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
George Washington University Hospital
Hazleton Laboratories
Hoffman LaRoche Incorporated
Litton Bionetics Incorporated
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
Temple University School of Medicine
The Upjohn Company
Thomas Jefferson University
Union Carbide Corporation
University of Kansas Medical Center
University of Southern California
University of Texas, Austin

RATS (Continued)

FUNCTIONAL TESTS (Continued)

Bilirubin

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynamics
Chemical Industry Institute of Toxicology
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University School of Medicine
The Upjohn Company
University of Southern California

Radioisotopic Techniques

Albert Einstein College of Medicine
Bio-Dynamics
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University School of Medicine
Thomas Jefferson University
University of California, Irvine
University of Pittsburgh Medical School
University of Southern California
University of Texas (UTMB)
U.S. Army Environmental Hygiene Agency

RATS (Continued)

BIOCHEMICAL TESTS (Continued)

Membrane Integrity

Food Research Institute
Thomas Jefferson University
University of Arizona

Serum Enzyme Levels

Albert Einstein College of Medicine
Bio-Dynamics
Chemical Industry Institute of Toxicology
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
George Washington University Hospital
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Medical College of Virginia
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University School of Medicine
The Upjohn Company
University of Arizona
University of Kansas Medical Center
University of Michigan
University of Pittsburgh Medical School
University of Southern California
University of Texas, Austin
University of Texas (UTMB)
University of Texas Medical School
University of Toronto
U.S. Army Environmental Hygiene Agency

RATS (Continued)

BIOCHEMICAL TESTS (Continued)

Carbohydrate Metabolism

Abbott Laboratories
Bio-Dynamics
Chemical Industry Institute of Toxicology
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Medical College of Virginia
Midwest Research Institute
Monsanto Company
Rutgers Medical School (CMDNJ)
The Upjohn Company
University of Kansas Medical Center
University of Southern California
University of Texas, Austin

Lipid Metabolism

Abbott Laboratories
Albert Einstein College of Medicine
Baylor College of Medicine
Bio-Dynamics
Chemical Industry Institute of Toxicology
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Medical College of Virginia
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)

RATS (Continued)

BIOCHEMICAL TESTS (Continued)

Temple University
The Upjohn Company
University of Michigan
University of Pittsburgh Medical School
University of Southern California

Protein Metabolism

Abbott Laboratories
Albert Einstein College of Medicine
Baylor College of Medicine
Bio-Dynamics
Chemical Industry Institute of Toxicology
Dow Chemical USA
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Medical College of Virginia
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Rutgers Medical School (CMDNJ)
The Upjohn Company
Thomas Jefferson University
University of Arizona
University of Kansas Medical Center
University of Michigan
University of Pittsburgh Medical School
University of Southern California
University of Texas, Austin
University of Texas Medical School
University of Texas (UTMB)
U.S. Army Environmental Hygiene Agency

Nitrogen Metabolism

Dow Chemical USA
Hoffman LaRoche Incorporated
University of Texas, Austin

RATS (Continued)

BIOCHEMICAL TESTS (Continued)

Xenobiotic Metabolism

Albert Einstein College of Medicine
Baylor College of Medicine
Dow Chemical USA
Duke Medical Center
Food Research Institute
G.D. Searle and Company
George Washington University Hospital
Litton Bionetics Incorporated
Medical College of Virginia
Midwest Research Institute
National Institute of Environmental Health Sciences
Naylor Dana Institute
Rutgers Medical School (CMDNJ)
Sterling Winthrop Research Institute
Temple University
Temple University School of Medicine
Thomas Jefferson University
Union Carbide Corporation
University of Arizona
University of California, Irvine
University of California, San Francisco
University of Kansas Medical Center
University of Southern California
University of Texas, Austin
University of Texas Medical School
University of Texas (UTMB)
University of Toronto

Drug Metabolism

Food Research Institute
Massachusetts Institute of Technology
Midwest Research Institute
Temple University School of Medicine
The Upjohn Company

Levels of Serum Metals and Electrolytes

Abbott Laboratories
Albert Einstein College of Medicine
Bio-Dynamics
Chemical Industry Institute of Toxicology

RATS (Continued)

BIOCHEMICAL TESTS (Continued)

Food and Drug Research Laboratories
G.D. Searle and Company
Hoffman LaRoche Incorporated
International Research and Development Corporation
Litton Bionetics Incorporated
3M-Riker Laboratories
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
Sterling Winthrop Research Institute
Temple University School of Medicine
The Upjohn Company
Union Carbide Corporation
University of Texas (UTMB)
U.S. Army Environmental Hygiene Agency

Levels of Tissue Liver Metals

Massachusetts Institute of Technology

Vitamin Assays

Massachusetts Institute of Technology

Vitamin Metabolism

Abbott Laboratories
Bio-Dynamics
Food and Drug Research Laboratories
Hoffman LaRoche Incorporated
International Research and Development Corporation
Midwest Research Institute
Rutgers Medical School (CMDNJ)
The Upjohn Company
University of Pittsburgh Medical School
University of Texas (UTMB)

Tissue Enzyme Levels

Massachusetts Institute of Technology
Thomas Jefferson University

RATS (Continued)

BIOCHEMICAL TESTS (Concluded)

Detoxification and Product Synthesis

Bio-Dynamics
Exxon Corporation
Food and Drug Research Laboratories
G.D. Searle and Company
Hazleton Laboratories
International Research and Development Corporation
Massachusetts Institute of Technology
Midwest Research Institute
Monsanto Company
National Institute of Environmental Health Sciences
Naylor Dana Institute
Sterling Winthrop Research Institute
Temple University School of Medicine
Thomas Jefferson University
University of Arizona
University of California, Irvine
University of Southern California
University of Texas (UTMB)
U.S. Army Environmental Hygiene Agency

IN VITRO TECHNIQUES

Isolated Perfused Liver

Albert Einstein College of Medicine
George Washington University Hospital

Hepatocytes

Albert Einstein College of Medicine
Chemical Industry Institute of Toxicology
Dow Chemical USA
Food Research Institute
George Washington University Hospital
Medical College of Virginia
Midwest Research Institute
Thomas Jefferson University
University of Arizona
University of Kansas Medical Center
University of Southern California
University of Texas (UTMB)

RATS (Concluded)

IN VITRO TECHNIQUES (Concluded)

Hepatoma Cells

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Food Research Institute
Midwest Research Institute
Rutgers Medical School (CMDNJ)
University of Arizona
University of Kansas Medical Center
University of Southern California

Membrane Integrity

Albert Einstein College of Medicine

Cell Necrosis

Naylor Dana Institute

DNA Damage

Chemical Industry Institute of Toxicology
Duke Medical Center
Naylor Dana Institute

Mutagenesis

Naylor Dana Institute

Alterations of Membrane Functions in Isolated Organelles

University of Southern California

SHEEP

Albert Einstein College of Medicine

MORPHOLOGICAL AND HISTOPATHOLOGICAL TESTS

Albert Einstein College of Medicine

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Radioisotopic Techniques

Albert Einstein College of Medicine

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Lipid Metabolism

Albert Einstein College of Medicine

Protein Metabolism

Albert Einstein College of Medicine

Xenobiotic Metabolism

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Levels of Serum Metals and Electrolytes

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Albert Einstein College of Medicine

Hepatocytes

Albert Einstein College of Medicine

Hepatoma Cells

Albert Einstein College of Medicine

Membrane Integrity

Albert Einstein College of Medicine

APPENDIX C
INDEX OF INDIVIDUALS IN THE DIRECTORY

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